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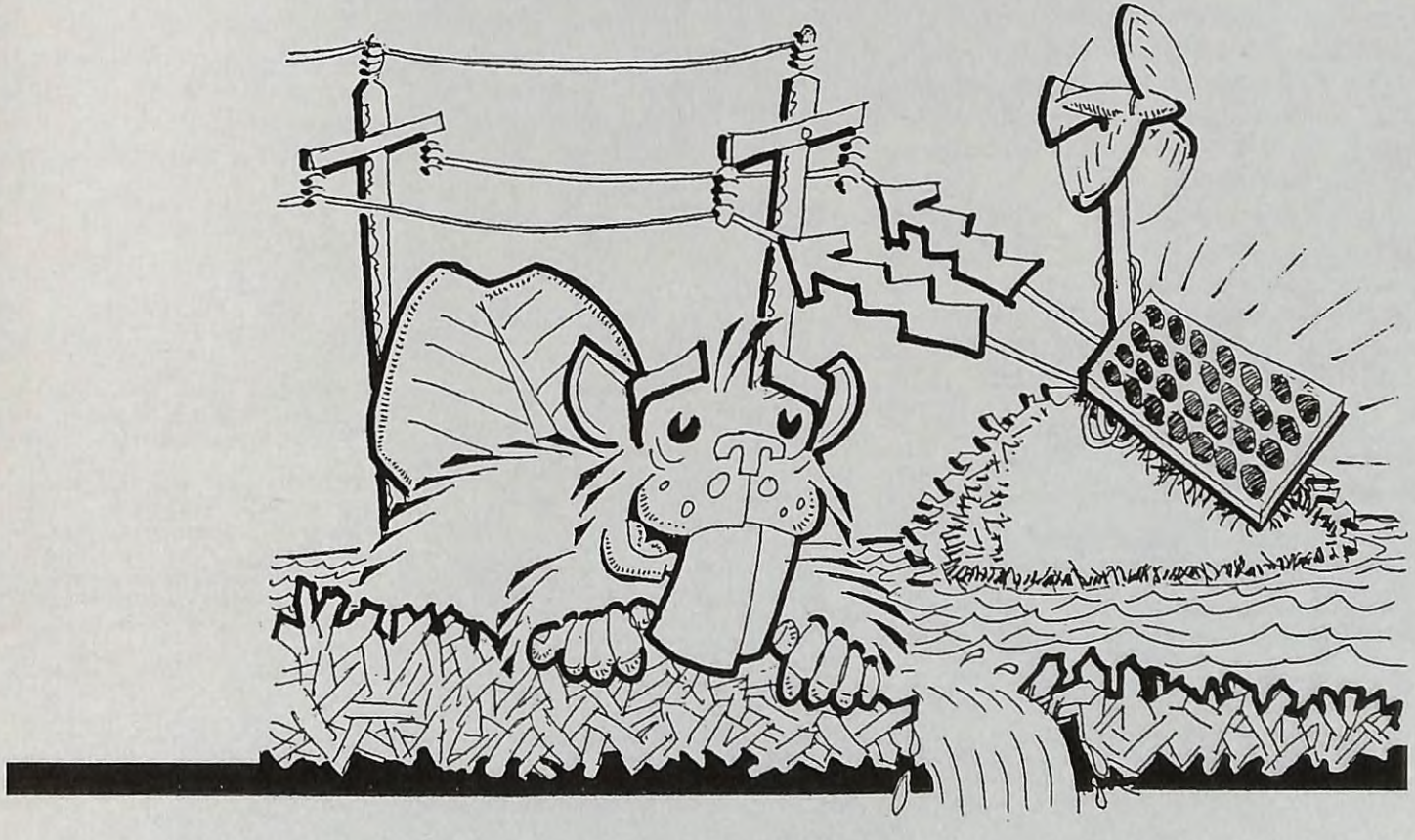
Zero-Energy Houses



From the Editor

Everyone understands the importance of clean air and water. No one willingly sets out to destroy a healthy environment. Yet everyone is in favour of good deeds as long as they don't actually have to do anything.

The development industry has loudly stated its support of "green" building initiatives. These include improved energy efficiency, resource-efficient designs, materials with low embodied energy and recycled content, and attention to indoor air quality by design.

But while everyone is supportive, they do so without actually taking action. Otherwise, we would be seeing R-2000 houses on every block and most large buildings would be energy efficient with superior indoor air quality. Instead, at best there is a lot of "greenwash" - token steps with little real impact. And much commentary to the effect that no one is asking for energy and environmental upgrades. But consumers aren't even given the option.

Although new home buyers may fixate on the cabinets, floors and fancy hardware, they also are interested in the substance of the building. I recently heard the results of one study that found that the average new home buyer was willing to pay about $1900 extra for energy efficiency options, while builders said they thought the maximum was $ 800. This may explain why too often buyers aren't presented with any real options.

In the commercial, institutional and multi-family construction sectors, guidelines for sustainable construction include the C-2000 standard or the recently developed LEED™ rating system. LEED is a voluntary, consensus-based standard for high-performance, sustainable buildings. It was developed to promote integrated building design and to transform the market. A Canadian version has just been released. LEED has attracted considerable interest and is quickly becoming the standard for green construction. In the residential sector, we have the R-2000 Standard.

However, recent comments heard around Vancouver got me thinking about the challenge we face. Local public sector agencies and governments have been actively pursuing sustainability initiatives, but are having a hard time moving beyond a few public sector buildings. Now pressure is growing to incorporate the ideas into new multi-unit residential buildings. At the same time commitments have been made to build the 2010 Olympic infrastructure as LEED certified buildings.

Suddenly, some in the development industry are realizing that this green building thing is real and they will be expected to deliver. As a result, all manner of questions are being asked and perceived obstacles are surfacing. This from an industry that has professed to be supplying what the public wants.

Just as a groundswell is emerging, and the market is starting to ask for green buildings, industry reaction seems to be following Henry Ford's marketing strategy. He was quoted as saying that buyers could have any colour car as long as it was the black car he was manufacturing.

I realize that there may still be unresolved issues with some technologies. Regulators may have difficulty with some alternative design approaches. But we can always deal with legitimate concerns. Nothing is ever static and there are always new designs, new products, and new ways of building. Concerns about these new directions should not be used as an excuse to avoid moving forward and taking more aggressive steps toward a sustainable future. What we build today will consume ever more expensive resources long after we are gone.

Richard Kadulski,
Editor

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Zero-Energy Houses

A Net-Zero Energy Home is a home that on balance, over the year takes nothing from the grid. It supplies to the electrical grid as much electricity as it purchases from the grid.

Affordable energy efficient homes are being built in all parts of the country. Although the average R-2000 house uses 40 to 50% less energy than a conventional new house, we know we can do even better than that. The Advanced Houses built in 1993 had a purchased energy consumption target of 50% less than the R-2000 energy target. This was equivalent to about 25% of the purchased energy of a conventionally constructed house. While monitoring showed these houses did not quite achieve this target, they did come close. The projects pointed out the challenges of achieving aggressive energy conserving performance.

Although it may be a challenge at times, even in Canada, it is possible to build houses that do not need a furnace. The current owners of the BC Advanced House discovered that after one year of living in it. They observed that the heating system controls did not seem to be responding to adjustments. On investigation it was discovered that the controls were not functional because they had been damaged by a prior occupant. But this was noticed only after the occupants had been in the house for a year. They had been living in the house for a year without a heating system - and didn't know it, and didn't suffer for it.

While homes without a furnace, fully autonomous houses, or Net Zero-Energy homes are still rare, increasingly more energy efficient homes are being built throughout the world. These efforts are not just focussed on new construction, but also at retrofitting existing buildings, since many older, less efficient buildings will still be in service for many years to come.

The US Energy Star new home program, which could be considered a kind of "R-2000 Lite" is gaining increased acceptance with homes being built all over the US. The Energy Star designation is awarded to homes that are at least 30% more energy efficient than local building or energy code requirements.

The US Department of Energy's National Renewable Energy Laboratory (NREL) has supported a demonstration project to build four zero-energy homes across the US. The intent is to introduce the zero-energy home concept to the construction industry for single-family homes. Each house combines energy efficient construction with active and passive solar energy systems, allowing the house to return as much energy to the electrical grid over the course of a year as it uses. Thanks to net metering, the home's electric meter spins backwards when more power is generated than is being used, allowing the homeowner to earn credit for the electricity that is fed into the power grid.

Net-Zero Energy Home Coalition Launched to Promote Solutions to Sustainable Residential Building Design and Construction in Canada

A coalition has been formed to promote homes that take advantage of energy efficiency and onsite green energy technology applications. The coalition will also promote the economic development and environmental benefits of green energy technologies and energy efficiency applications and devices.

They are urging the federal and provincial governments to implement a market oriented solution that leverages the use of incentives aimed at offering new home buyers greater opportunities to install onsite renewable energy generation and enhanced energy efficiency that, when combined, will result in a Net-Zero Energy Home.

The Net-Zero Energy Home will build upon Canada's pioneering work in energy efficient home construction through the R-2000 Standard. It will empower Canadians to make an even greater contribution to the environment. It offers an integrated and comprehensive approach to developing and implementing onsite "green"

energy technologies leading to a significant reduction in greenhouse gas emissions, cleaner air and economic development. In many cases with proper design the entire energy consumption (heating, cooling and electrical) of a home can be provided by renewable energy sources.

The Net-Zero Energy Home creates the opportunity for Canada to take global leadership in adopting the world's first national residential strategy for net-zero energy homes. The coalition is seeking a combination of:

- A federal government commitment to offer a reduction of the GST from the purchase of a new home and,
- A commitment from provinces to offer a provincial sales tax exemption or equivalent from the costs of materials used in the construction of the new home.

These abatements would be used to upgrade the home's efficiency to at least an R-2000 rating and to offset the premium of installing the heat pumps, solar thermal or solar PV systems.

Net-Zero Energy Home Coalition

The idea for the Net-Zero Energy Home was developed last year after the blackout that affected large portions of Central Canada and the US. The goal was to examine opportunities for reduced electricity consumption and decentralized onsite generation. It was realized that renewable energy technologies and energy efficiency/conservation technologies which would allow homes to consume no electricity from the power grid (on an annual net basis) and significantly reduce greenhouse gas emissions are already available.

The economy of the future will be led by those countries, with the support of those governments, that recognize and believe in the need to adapt to an ever-changing environment and economy. Canadian energy markets are facing an enormous challenge and change. Addressing this effectively will require the need for the conservation and strategic development of all available renewable energy resources and technologies.

The coalition was formed by a group of home builders, developers of decentralized renewable energy systems and companies and organizations dedicated to the belief that existing technologies are already available to enable the deployment of Net-Zero Energy Homes across Canada. Members of the coalition include Thomasfield Homes, Dupont Canada Inc., Earth Energy Society of Canada, Xantrex Technology Inc., Canadian Solar Industries Association, Milton Hydro Distribution Inc., Spheral Solar Power Inc. (a subsidiary of ATS Automation Tooling Systems Inc), Canadian Energy Efficiency Alliance and EnerQuality Corporation.

What Will a Net-zero Energy Home Look Like?

At minimum, the Net-Zero Energy Home would be built to the R-2000 standard. This means a home design and construction that features higher levels of insulation and more efficient mechanical systems so that heating and hot water energy consumption are reduced by at least 40% compared to a standard new home. This energy consumption can be reduced further by using EnerStar appliances. In addition, the home would include onsite renewable energy devices such as geothermal, solar thermal panels (for water heating) and a 3 kW rooftop solar electric photovoltaic array to generate electricity for the grid. In sum, the total power generated on site would be equal to the power it purchases from the utility.

The coalition is setting as its initial target 2% of the new home market. They estimate that wide adoption of these approaches would lead to the creation of 216,000 direct jobs, 50 new factories would be constructed, and $1.2 billion in tax revenue would go back to governments.

What Are the Advantages of Net-Zero Energy Homes?

We have relied on centralized electrical power systems that favour relatively few but large generating stations, such as huge hydro-electric dams or nuclear power plants. This means that when problems emerge in any single generating plant, there may not be enough redundancy in the system to cope when breakdowns happen. The traditional centralized electrical power generation system impedes the availability of sustainable energy options. Although conservationists have been pointing it out for many years, it is only recently that the benefits of distributed electrical generation have begun to be acknowledged.

Electrical generation sources like building integrated photovoltaics or wind power should be an important component of an energy strategy that also looks at enhanced energy efficiency, conservation and reliability. Many smaller production points, grid connected, stabilize power security and reduce the total capacity required by the grid.

Large energy utilities have resisted independent power production, ostensibly because of safety or management concerns. Today new meter technologies and automated system management make administration and meter reading easier and more reliable, making it easier to deal with a very decentralized production system including reversible meters. Two-way meters mean that when there is more electrical production than is needed by the house, the power is sent to the grid, and the electrical meter runs backwards, "selling" the power. Reversible meters are common in some areas in the US.

Through the combined use of onsite renewable energy generation and energy efficiency technologies and appliances, new home construction design by 2030 could meet a net-zero energy standard resulting in the benefits of an expanded renewable energy industry in Canada. ☼

Swedish Homes without Heating Systems

Is it possible to build a house without a heating system in a cold northern climate? If we are to come to terms with global climate change issues, we will have to move in that direction, and quickly. An ambitious 20 unit townhouse project built in Göteborg, Sweden, set out to do just that. The results show what can be done, and also point out some of the challenges involved.

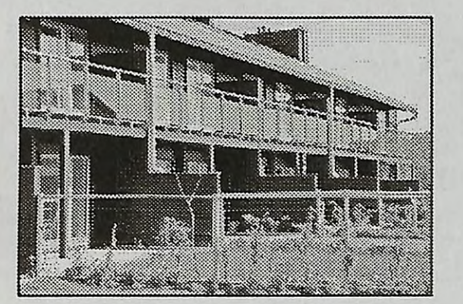
The buildings were designed to provide a pleasant indoor environment meeting demanding Swedish standards with minimum energy use under local climatic conditions. Göteborg is north-east of Copenhagen, Denmark, at a latitude of 57°N which means short winter days. Although further north than Edmonton, the climate is not quite as cold (see table). Göteborg has a winter design temperature of -17°C and low temperatures over extended periods are rare.

The units are 36 ft deep row houses, so there is a smaller exterior wall area than in a detached single family house. The designs were oriented to make full use of available solar heat. South-facing elevations have larger windows, while balconies and roof overhangs protect against overheating during the summer. A modestly sized operable skylight over the staircase gives light to the middle of the house, and is also used for ventilation in the summer.

Exterior walls are very well insulated and airtight. The walls are 18" thick frame walls with multiple layers of insulation with an overall R-value of 58.

The roof construction is engineered wood joists, 19" deep with full depth insulation with an overall R-value of 64.

The foundation is a concrete slab-on-grade placed over 10" of rigid expanded polystyrene insulation with a total R-value of 64.



The windows are triple glazed units. Two panes have soft coat low-e, and the gas fill is krypton. The overall R-value is 6.7. Adding coatings to glass and multiple panes of glass can reduce the amount of light entering through the window. The light transmittance of the windows used is 63%, compared to the 82% transmittance of a standard double-glazed clear glass window.

The units are very airtight - the blower door results were 0.5 ACH at 50 Pascals. (The R-2000 Standard limit is 1.5 ACH).

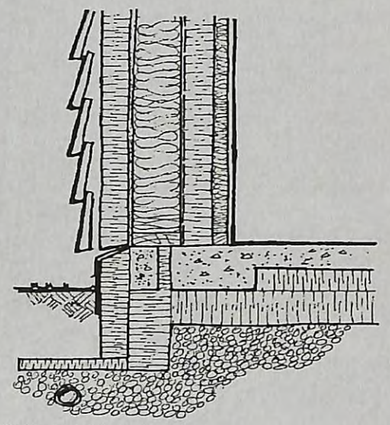
Heating

The buildings were designed to take into account the heat generated by the occupants,

City	Latitutde	Winter Design Temp °C	Degree Days °C	Annual Hours of sun
Goteborg	57 °N	-17 °C	4196*	1576
Edmonton AB	53 °N	-32 °C	5400 *(3969**)*	2173
Montreal	45 °N	-23 °C	4550 *(3048**)*	1811
Toronto	43 °N	-20 °C	4050 *(2599**)*	2047

* Heating degree days is a measure of the severity of the climate. It is the sum of the average degrees difference from a reference temperature times the number of days. Canadian heating degree days are based on 18°C. The Swedish degree days are based on 12°C.

** For comparison, equivalent degree days based on 12.7°C



Wall: Outside to inside:
wood siding on rain screen
4" (100 mm) EPS polystyrene
⅜" (9 mm) gypsum board
6 ½" (170 mm) mineral wool + studs & vapour barrier
4 ¾" (120 mm) EPS polystyrene
2" (45 mm) mineral wool + studs
½" (13 mm) gypsum board interior

Ground floor construction:
(Inside to outside)
4" (100 mm) concrete
4" (100 mm) EPS polystyrene
vapour barrier
6" (150 mm) EPS polystyrene
6" (150 mm) drainage layer

appliances and lighting. The heat supplied by occupants was estimated to be 1200 kWh/year. Heat generated by the lighting, fridge, freezer, stove and other appliances was estimated to be about 2900 kWh/year if the most energy efficient appliances available in the market were used. Fresh air is preheated by the exhaust air in a heat ventilator.

Hot water

Hot water is heated by five square metres (53 sq. ft) in area solar collectors per dwelling. These were estimated to provide about half the annual hot water needed. An electric immersion heater in the 500 litre storage tank was to provide the rest.

Ventilation

The ventilation system uses an 85% efficient heat recovery ventilator. In the summer the HRV can be turned off and the house ventilated passively using only the exhaust fan and open windows.

Costs

Building costs were estimated to match standard construction when the extra insulation, more careful detailing of airtightness, and high efficiency heat recovery ventilation were balanced off by the much lower costs of the heating system, adaptation of the design to optimize passive solar heat gains and savings in operating energy costs.

At the design stage, the total estimated energy use in a normal year, assuming an indoor temperature of 20°C for household electricity, hot water, fans, pumps etc. was a total of 5400 kWh or 43 kWh/m² per year.

Did these houses meet expectations?

After a year of monitoring, the results show they were close to the target, but didn't quite make it. The total electrical use was 6860 kWh or 54 kWh/m² per year. In part, the difference was that the indoor temperature was closer to 23°C. Monitoring is continuing through 2004.

To put these numbers in context, the amount of energy needed for space heating these units was only 9.7 kWh/m² per year, while the Swedish building code standard for an equivalent unit is 54 kWh/m² per year. The numbers for typical houses in Canada would be about 90 kWh/m2 per year for standard building code compliant houses, while for R-2000 houses it would be about 47 to 50 kWh/m² per year.

Dwellings without a furnace do not require significant lifestyle changes. Obviously, a house without a heating system demands that those who live in it modify their behaviour, but mostly it is a matter of using common sense. If it is cold outside, occupants should not open the windows to create a through draft. If it is warm and sunny, they should lower the blinds or the awnings outside the south windows.

Passive solar gains in these units ranged from 700 to 1100 kWh. It was observed that unoccupied interior units can maintain a temperature of 20°C. End units that are unoccupied for a longer period could see interior temperatures fall below 20°C. In any event, when there is no one at home, a variation in temperatures is acceptable. ☼

Seabird Island First Nation Sustainable Community Demonstration Project

It's been well documented that there is a housing crisis in aboriginal communities across the country. Many factors have led to this situation, which is being made worse by changing demographics. Aboriginal people are the fastest growing segment of Canada's population and their life expectancy is steadily increasing, creating a demand for adaptable, barrier-free housing that can meet the needs of both growing families and elders. In addition, more and more people are returning to their communities, putting pressure on already strained housing resources. More high quality, affordable homes are needed to house this growing population.

Many of the homes in these communities are old, overcrowded, and in need of repair or replacing, but their location makes building new housing a challenge. Many First Nations communities are remote and have no access to the urban power grid or other infrastructure - they need achievable energy efficiency solutions. Resource-efficient design that uses local materials, durable construction techniques and products, and ones the community can build and repair, are a necessity.

The Seabird Island Project is a seven-home project that was built by the Seabird Island First Nation near Agassiz, 150 km east of Vancouver, BC. It shows ways of addressing its housing needs and provides solutions that communities located in both remote and urban settings can apply.

The project is a partnership between the Seabird Island First Nation, Canada Mortgage and Housing Corporation (CMHC) and the Department of Indian Affairs Canada. The homes were designed under the direction of Seabird Island First Nation and CMHC by Broadway Architects in Vancouver, BC.

Six homes were funded within the guidelines of CMHC's Non-Profit On-Reserve Housing Program; the seventh is a demonstration home that will remain open for tours and public education for two years, after which time it will revert to residential use. The project is part of the Seabird Island First Nation's Sustainable Community Plan. The idea is to use land and design neighbourhoods in a way that reduces costs and minimizes environmental impacts, while creating a liveable community.

The Seabird Island homes are designed to be:

Affordable to build, operate and maintain.

Durable - using materials and construction techniques that will reduce future maintenance and repair problems.

Energy efficient - their design integrates renewable energy sources such as wind, solar and earth energy to save on heating and lighting costs. They have been designed to maximize passive solar gains. It is estimated that the energy costs will be reduced by at least 30%. Unfortunately, these homes were not built to the R-2000 Standard, and have not been airtightness tested.

Flexible - they use floor plans and barrier-free designs that can accommodate the changing needs of families.

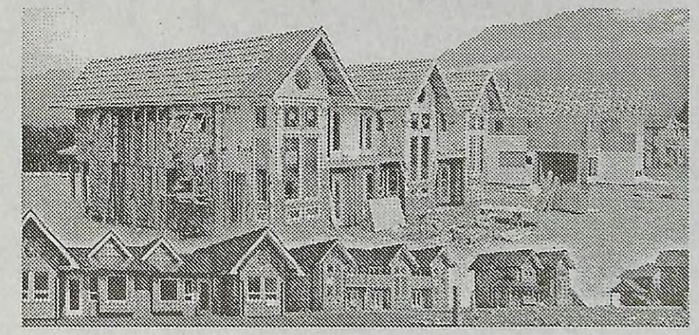
Healthy - they use healthy building materials, have superior indoor air quality and are more comfortable to live in.

Environmentally responsible - they conserve resources, use recycled materials and have a low environmental impact

Community oriented - they reflect the preferences, culture and needs of the community. Construction training of the crews working on the project and the use of local materials was a part of the project. This means that employment was created, supporting the local economy, and that maintenance can be done by the community members at a reasonable cost.

These requirements and many more were met by using design concepts promoted by CMHC's *FlexHousing* and *Healthy Housing* initiatives.

To ensure the project would be affordable for others to duplicate, it included appropriate



higher density development in the form of two single-family homes (with four to six bedrooms each), a triplex and a duplex - reinforcing the importance of using land efficiently and in a sustainable manner.

Solar design approaches have been incorporated into the design. In addition to passive solar orientation of windows, the dark-green metal roof of each house is used as a solar collector for an air system. Solar heated air is taken off the roof and ducted to the concrete slab. The slab-on-grade (insulated beneath the slab) has a series of 4" pipes embedded in it through which the solar heated air is circulated, so the slab acts a radiant heated slab. This is an approach that was tried with mixed results in the 1980s. Hopefully, a monitoring program will be implemented to determine just how effective these approaches are in practice.

Domestic hot water is preheated in a passive tank located under a window seat.

Earth tubes preheat/cool incoming outside air.

The site also has a prototype wind generator installed as a demonstration of how it can supply extra power. ☼

The Three-Litre House: German Energy Efficiency Retrofits

Most of the energy consumed by buildings is accounted for by old residential properties. Retrofits of older buildings can be a challenge.

It is estimated that at least 24 of the 34 million apartments in existing buildings in Germany are in need of renovations, especially in the older post-World War II buildings and in Eastern Germany. This points not only to the potential, but also to the challenge. Making noticeable cuts in energy consumption and significant reductions in CO_2 emissions requires extensive building insulation and the retrofitting of advanced heating technologies.

BASF is a large multi-national petrochemical company, well known as a supplier of building materials, including the building blocks for expanded polystyrene. In Germany, one of their subsidiaries is a housing company with a portfolio of 10,000 rental apartments. The company has set out to refurbish buildings in a 70-year-old district of Ludwigshafen, bringing the residential area up to modern standards and reducing energy consumption.

The old buildings are poorly insulated, if they have any insulation at all. Their space heating needs are in the order of 200 kWh/m². This compares to current energy efficiency standards, which means an annual energy consumption of about 70 kWh/m². (In Germany, this is referred to as the heating oil equivalent, or 7 litres per square metre.)

The BASF team decided to make the retrofit of one building as a demonstration of retrofitting to the highest standard possible. They set their space heating target as 30 kWh/m² and called this their 3-litre house. They also saw this as an opportunity to showcase BASF's new insulation and building products, and to show an example of what can be achieved when a comprehensive approach using the expertise of the entire project team is put to use.

When dealing with older buildings, the principle of the house-as-a-system must be considered. Foundations and basements, walls, windows and roofs cannot be viewed as individual, isolated components. The entire building envelope must be well insulated, and the airtightness of the building envelope as well as the thermal bridging must be considered.

In order to achieve an annual energy consumption equivalent to 3 litres of oil per square metre of floor area, the strategy BASF used was to:

- insulate and air-seal the exterior envelope
- replace existing windows with high performance windows
- install a heat recovery ventilation system
- replace the boiler with a high-efficiency unit
- install a fuel cell

Adding insulation to the external components of a building - the roof, walls, cellar roof or foundation slab provides the highest energy savings. Especially when installed from the exterior, it is possible to address the problem of thermal bridges and airtight construction.

The building was a traditional Central European masonry apartment building. A key part of the retrofit process was exterior insulation of the structure. The entire exterior of the building was clad with 20 cm (8") of ***Neopor***. (see p. 11)

The floor over the basement, which was treated as an exterior service space, received 14 cm (5 ½") of Neopor underneath the floor, and 6 cm (2 ¼") on top of the structural floor, under the finished floor.

On the roof, 9 cm of Neopor insulation was put between the rafters, and 20 cm on top.

Perimeter insulation for the foundation was a horizontal skirt of 18 cm board to insulate against frost.

The windows were replaced with new, state-of-the-art triple-glazed, double-coated windows with gas fill and insulated spacers.

A controllable heat recovery ventilation system ensured that all rooms got optimum ventilation at all times.

The interiors were refinished with a new interior plaster developed by BASF designed to retain latent heat. It ensures that the indoor climate is always comfortable and pleasant. Between 10 and 25% of the plaster is made up of a material that contains a form of wax particles that store latent heat. Between 750 and 1500 grams of wax are embedded in each square metre of wall surface. The heat absorption capacity of 2 cm (¾") of this plaster is equivalent to that of a 20 cm thick brick wall. As the temperature increases, the wax melts and thus stores heat; as a result, it stays cooler inside. As the temperature drops, the heat is given off. In order that the wax can be incorporated into paints or plaster, BASF researchers have packed it in micro capsules. ☼

Solar Electric Power Turns 50!

The first public solar demonstration took place 50 years ago. In April 1954, Bell Laboratories scientists unveiled the silicon solar cell. The demonstration of a small disk that could generate enough electricity to power a radio transmitter, without any moving parts, was science fiction come to life.

What was an astounding innovation fifty years ago has now become commonplace. At first, photovoltaic (solar) cells were critical to the space program as it was the solar cell that made space exploration possible. After all, satellites needed power, but couldn't use conventional fuel in the vacuum of space. Today small solar cells that generate enough power for electronic appliances have become so cheap that they can be used in giveaway solar calculators. Probably everyone now has at least one calculator or watch run by a solar cell.

After fifty years solar energy is, in many ways, just taking off. Across the US and around the world solar electric panels are sprouting on buildings, homes and businesses at record speed. Roof shingles that generate electricity are a novelty today for wealthy eccentrics, but new production capacity is coming on stream to lower cost. It will not be very long before solar roof shingles will become an option even for modest budgets. With changes in electric utility structure and management, reversible meters make building integrated photovoltaic cells economical.

Solar electricity is now the fastest growing energy source in the world, with production doubling every 30 months. The only question is, will government policies accelerate or slow the growth of this clean, reliable energy source?

The cost of solar cells has plummeted with their increased use. That early cell cost about $3,000 per watt. Today, panels are selling for about $1.50 per watt. At about $1.00 per watt, they are competitive with electricity selling for about $0.10/kW-hr. ☼

Worldwide solar electric production is expected to add 1,000 megawatts (MW) in 2004, on top of the 2,000 MW already in use.

For a child born this year, the sun will provide as much energy during that child's life as all US oil reserves.

Japan has recently overtaken the US as the solar manufacturing capital of the world, thanks to that nation's strong government commitment to deploying solar power.

The solar module displayed back in April 1954 still works.

R-2000 Requires Energy Efficient Motors

The goal of the R-2000 Standard is to improve the energy efficiency of new houses. Most attention has been given to the design and construction of building envelope elements which are key to building an energy efficient home. As the heating load of the home is reduced, the size and efficiency of the heating system becomes more important and must be carefully considered.

The R-2000 program has been an important driver for the development of higher efficiency mechanical equipment.

Manufacturers have put much effort to improving the design of combustion chambers and venting systems. Today high-efficiency gas furnaces typically are able to extract 90 to 92 % of the available heat out of the natural gas, and for oil burning appliances it is about 80%. These are near the limit of what can be squeezed out of the fuel. To optimize energy performance, these appliances do not have standing pilot lights.

However, efficiency ratings for furnaces measure only combustion efficiency and do not consider the energy consumption of blower motors. Forced air systems need motors to drive the fans that move the air.

Conventional motors used for blowers are not very energy efficient. The impact of the energy consumption of furnace motors has become apparent in recent years because the blowers are being operated continuously, as part of the ventilation system or if higher quality air filtration is part of the system design. Inefficient blowers, when operated continuously, can easily consume 2,000 kWh of electricity per year.

Fortunately, improved motors such as the ECM™ (electronically commutated motors) are available today. Much of the new heating equipment on the market today has more efficient motors - but these often have to be selected as options. Not all high efficiency equipment comes with the new blower motors as standard.

The R-2000 Standard has encouraged the use of equipment with ECM or equivalent motors, especially if the forced warm air heating systems are part of the ventilation system. That is about to become a requirement in the Standard. Effective April 1, 2005, forced-air heating systems (furnaces and fan coils) that are also used to distribute ventilation air must be able to reduce the electrical loads associated with conventional fan motor/blowers by at least 40%. This effectively requires that furnaces or fan coil units use ECM or equivalent motors.

New R-2000 Incentive for Efficient Motors

Natural Resources Canada is offering a financial incentive to licensed R-2000 builders to encourage the installation of equipment with energy-efficient motors in new R-2000 homes. Energy-efficient motors that qualify include brushless DC motors, DC variable speed motors and ECM™ motors. The incentive is $200 per house, payable to the builder, and is available immediately.

To qualify, the house will have to be enrolled in the R-2000 database before March 31, 2005, and the home must be certified between April 1, 2004, and October 31, 2005. Only installations in certified R-2000 homes are eligible for the incentive, and only one incentive payment will be made per house.

Applicable equipment:

* A furnace, regardless of fuel, that incorporates an energy-efficient motor
  a. If it is a natural gas or propane system, it must be listed at on the NRCan web site *www.oee.nrcan.gc.ca/energystar/english/consumers/gasfired_furnaces.cf*
  b. It must be on another approved list that NRCan will publish as the lists become available.
* A boiler system that incorporates an air handler with an energy-efficient motor within the air handler (documentation must be supplied)
* An HRV with an energy-efficient motor (documentation must be supplied)
* Any unlisted system must be supported by verifiable documentation showing that it meets requirements. NRCan will review equipment specifications for products not present in approved lists and determine whether a product shall be eligible for the incentive.

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 www.R-2000.ca

Letter to the Editor

Re: CCA Treated Wood (Solplan Review No. 115 March 2004)

Thanks for the article in the March 2004 on Treated Wood. Nice to see a clear article on the subject which doesn't take a "the sky is falling" approach!

In my opinion, a significant omission from the article is a discussion about borate treated wood products, one version of which is DOT (disodium octaborate tetrahydrate). There are number of benefits to DOT which may make it more palatable than using the copper-based treatments:

- Borate-based treatment is environmentally friendly (boron is a natural product). Waste material is not harmful to humans or landfill.
- Borates are fungicides and insecticides. Borate treated wood was originally used as a response to ants and termites.
- Borate-based treatment has a long and successful history (it was required in New Zealand for a long time).
- DOT treatment permeates throughout the entire piece of wood, not just the surface. End-cut treatment is not as critical, especially for small dimensions.
- DOT treated wood does not require special attention to fastener selection as there is no copper to accelerate a galvanic cell. This means you can get away with plated nails.

The big advantage to allowing plated nails over hot-dipped is that nail guns can be used. Decent hot-dipped nail guns are rare due to the difficulty of obtaining nail strings that work, especially when you look at the G90 and higher levels of coating. This means workers must use traditional hand-nailing, which is laborious (and therefore expensive) and damaging to surrounding finishes (especially in rehabilitation work). Construction site efficiency (and hence price) are badly affected by heavily hot dipped nails. As the only other option is stainless steel, the costs can be high regardless.

One stated disadvantage is that the DOT treatment is water-based, which means that heavy repeated wetting can leach out treatment. The amount of wetting required to leach out treatment is significant in that the water must first saturate the wood fibres, dissolve the borate, and then the water must be continuous and running, such that the treatment is carried away. Local standing pools of water are not generally harmful.

I like the stuff because it is environmentally friendlier than the copper treatments.

When comparing price, remember to compare DOT treated to CAN/CSA O80.34 to the others which have been treated to the proper CAN/CSA O80.2 or equivalent standards. Comparing apples-to-apples is important here.

Dave Kayll, Sr. Building Science Engineer
Morrison Hershfield Limited
Ottawa, ON

Neopor is a recently developed type of expanded polystyrene board by BASF that contains microscopically small flakes of graphite that reflect heat and make the board virtually impermeable to thermal radiation (and gives it its silvery-grey colour). Neopor has a higher thermal insulation capacity than conventional polystyrene.

Neopor can be up to 20% thinner than a conventional polystyrene board with the same density and the same insulating performance. Because less raw material is needed for the same insulation performance, there are savings in costs and resources. It is especially beneficial where higher R-Values are desired.

It takes about 10 litres of crude oil to produce 2 square metres of 10 cm thick Neopor, but this same board can save approximately 1,200 litres of heating oil over a period of 50 years.

Lennox Completeheat Update

In the past, we've criticized Lennox for fitting a premium product, the Lennox Completeheat combination water heater and forced air fan coil, with a low efficiency blower motor although the water heater is a condensing unit with an efficiency of 92%. The result was that, while gas consumption may have been low, builders received complaints about high electrical consumption when the blower was running continuously as part of the ventilation system. In a few cases the heat generated by the inefficient blower motor (which can be the equivalent of 4 or 5 100-watt light bulbs) helped overheat energy efficient homes in the summer.

We can report that finally the Lennox Completeheat combination water heater and furnace unit now comes with an ECM motor.

Technical Research Committee News

Canadian Home Builders' Association

Mould: How bad is the problem, how to deal with it, and how to avoid it

Mould in buildings has received much attention recently. To try to separate fact from fiction, CHBA has prepared a paper entitled Health and Housing, which examines the state of knowledge about various indoor pollutants including mould. Some moulds have health effects and in some cases specialized expertise is required to deal with them.

The CMHC web site provides useful advice on how to deal with mould called *Fighting Mold – The Homeowners' Guide.*

The Canadian Wood Council web site provides good information on this subject and on how mould differs from harmless discolouration. Avoiding mould problems in new housing is achieved through good moisture management. This means keeping water out of the wall, using assemblies that dry well if they get wet, and ventilating properly. Problem-prone climates call for more robust systems.

The Wood Council has also prepared a fact sheet titled Discolorations on Wood Products: Causes and Implications. Many things can stain wood, including dirt and iron, natural colour variations between the heartwood portion of the tree and the sapwood, and weathering. Some wood stains are the result of the growth of microscopic organisms, the most common of which are harmless staining fungi.

Other fungi can potentially colonize wood products. However, the vast majority of fungal species have no direct impact on people. Fungi needs air, nutrients and water. Air is readily available. Unlike plants, fungi cannot make their own food but rely on breaking down complex organic substrates into simple nutrients that sustain life.

Wood is not a preferred material by most fungi as it is low in nitrogen, sugars and starches. Wood primarily consists of cellulose (strong fibres) and lignin (the glue that holds them in place). Some fungi can digest cellulose, but cellulose is protected in wood by a natural coating of lignin, and only a few wood-rotting fungi can break this coating. Additionally, heartwood (the centre of the tree and the bulk of the wood in many species) contains naturally occurring compounds that can inhibit fungal growth and is poor in nutrients.

Products that include paper or fibres, such as acoustic tiles, wallpaper and drywall surfaces, are often more favourable for mould growth than wood because the pulping process removes lignin, thus making cellulose available to the fungi.

Fungi require a moist environment and water is most likely to be the limiting factor for fungal growth. Water sources can be in vapour or liquid form, including the liquid water that is created when vapour in moist air condenses on a cold surface.

Green lumber may be pre-treated with fungicide to control stain, mould and decay fungi. Lumber pressure-treated with wood preservatives to control decay is more resistant to but not completely immune from mould. Lumber production often involves kiln drying, where the heat from the kiln destroys any fungi in the wood. After drying there is not enough water in the wood to enable re-infection by moulds or other fungi. However, kiln dried wood must be protected from rewetting to prevent re-infection.

Information:
CHBA: www.chba.ca
CMHC: www.cmhc-schl.gc.ca
Canadian Wood Council: www.cwc.ca

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.
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Vermiculite Alert

Health Canada has issued an alert that some vermiculite insulation may contain asbestos fibres. There could be a health risk if the material is disturbed during maintenance, renovation or demolition. However, there is no evidence of risk to health if the insulation is sealed behind wallboards and floorboards, isolated in an attic, or otherwise kept from exposure to the interior environment.

Vermiculite was used in a variety of commercial and consumer insulation products because of its fire-resistant and insulation qualities. Of concern is vermiculite produced by the Libby Mine in Montana from the 1920s to 1990, which supplied the majority of the world market. It was sold as Zonolite® Attic Insulation and possibly other brands in Canada during that time. Vermiculite from the Libby Mine has not been widely used after the mid-1980s and has not been on the market in Canada for more than 10 years.

Not all vermiculite produced before 1990 contains asbestos fibres. However, to be safe and in the absence of evidence to the contrary, it is reasonable to assume that if a building has older vermiculite-based insulation, it may contain some asbestos. If vermiculite is found on a job site, then asbestos remediation procedures should be followed.

Liability Insurance for Builders

Builders' liability insurance continues to be a major concern. CMHC has recently released a report entitled Insurance in Residential Construction: An Environmental Scan, which confirms that dramatic cost increases have outstripped increases in construction costs and that exclusions and warranties have increased while the number of carriers has decreased.☼

Tankless Water Heater

Water heating is a major energy load in every house. Depending on the house design and envelope construction, hot water heating can represent half a home's energy consumption. That is why a water heater is an important appliance to consider if we want to reduce energy consumption.

The water heating equipment used today is very inefficient. The standard gas fired storage tank water heater found in most houses has an efficiency of about 45-50%. Even direct vent gas water heaters, which are considered to be better, are only about 58% efficient on a seasonal basis.

By comparison, the tankless water heaters commonly used in Europe and Asia have an efficiency rating in the range of 70-80%. The major shortcoming of the tankless water heaters is their limited hot water output. Since they heat water only as it is drawn and moves past the flame, the limit is the capacity of the burner and pipe size in the heater coil. Typically, they deliver 2-3 US gallons per minute. As a result, most tankless water heaters for the residential market only have the capacity to provide the hot water needs for one or two appliances at one time - for example, a single shower and a sink faucet.

However, it seems that we in Canada need to multi-task. We want to wash dishes, do laundry and have a shower and run a bath all at the same time. The small tankless water heaters are not able to keep up with such water loads. That is why when they are used they are often installed with some form of storage tank to act as a buffer.

In Europe and Asia, they are effective and widely used because household water use is smaller and water use patterns are better matched to the capacity of the heaters.

A Canadian company, IBC technologies of Vancouver, is now manufacturing a wall-mounted tankless condensing boiler that is capable of meeting the largest water loads. They have developed what may be the most efficient tankless natural gas water heater on the market, with an efficiency of 92% AFUE

The IBC boiler is a sealed combustion unit with automotive style fuel mixing within a fully modulating fire. It can deliver as much or as little hot water as needed. The staged output goes from 15,000 BTU to 150,000 in ten steps. This compares to other gas fired heaters with staged firing which have a more limited firing range, usually only two or three large increments. The very fine firing range is achieved by the use of state-of-the-art gas valves manufactured in Europe.

The boiler unit comes with built-in computer controls that are pre-programmed but that can be easily modified on site to suit the user's needs.

For space-challenged locations, the boiler has a very generous venting option which means it doesn't have to be mounted on or near an outside wall. With a 3" ABS or PVC vent pipe, the vent can be as much as 120 equivalent feet, through the wall or roof.

The IBC wall mounted boiler is a compact unit 34" high, 22.5" wide and 12" deep and weights 180 lbs.☼

Information
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NRC·CNRC

Insights into NRC Building Science Insight Seminar Series

By Madeleine Z. Rousseau

As a speaker and coordinator of NRC Building Science Insight (BSI) 2003 Seminar Series[1], I found the discussions with participants – whether in the formal part of the seminar or during the breaks – were always enlightening. Many interesting points of view were brought forward, such as about characteristics of the local climate, the overwhelming amount of technical information available on the internet, the uncertainty about performance of certain materials in certain applications and the challenges of making the right decisions for a specific project and its budget. Here is a collection of observations and questions that came up regularly in the discussions about heat, air and moisture flows in exterior walls with the associated risk of condensation.

The House as a System

In the last thirty years we have witnessed major changes in the way buildings are designed, built and operated in Canada. The energy crisis of the 1970s had a major effect on building technology related to energy efficiency. With hindsight, certain "domino" effects of changes in building technology took place as well. In the early years, higher insulation levels alone were placed into the building envelope. Without consideration for the associated need for additional envelope airtightness, the risk of interstitial condensation in the "colder" layers of the wall or roof increased. Additional airtightness was then implemented while the need for adequate mechanical ventilation indoors was not well understood at the time. This may have resulted in increased risk of poor indoor air quality, backdrafting of combustion equipment and surface condensation (and moulds) on cooler interior surfaces of walls and ceilings (e.g., glazing, elements acting as thermal bridges or poorly heated surfaces). Eventually, a better understanding and appreciation for the "house as a system" grew so that a series of measures would be implemented and better harmonized together for the sake of the building envelope and the occupants.

Madeleine Z. Rousseau is a researcher in the Building Envelope and Structure program of the National Research Council's Institute for Research in Construction. Ms Rousseau coordinated the delivery of NRC Building Science Insight 2003 Seminar Series, and presented her talk and paper on condensation control in exterior walls from coast to coast.

[1] The BSI seminar Series is now completed. Interested parties can view a description of the program at http://irc.nrc-cnrc.gc.ca/bsi/2003/index.html. IRC will release all seven papers presented at the seminar on its website in July 2004.

Emphasis on the Control of Moisture Accumulation in Exterior Walls : a Pendulum Effect?

The building science principles related to the mechanisms of indoor moisture transport into the enclosure as well as the requirements for proper control strategies have been widely popularized in the last 20 years. Since then, specific requirements for air leakageand vapour diffusion control have been integrated into trade manuals, federal publications, regulatory documents, and building science courses offered in colleges and universities. This dissemination of information must have borne some fruit in terms of improved building envelope performance because there seems to be much less talk of failures related to condensation in low-rise buildings than in the past, judging from the number of studies on the topic presented at conferences and seminars. In fact, the late 1990s have been marked by moisture problems originating due to inadequate rain penetration control strategies on building façades, mainly at the joints between elements that penetrate through the building envelope (e.g. windows, doors, balconies and decks), rather than interstitial condensation originating from indoor moisture sources.

Integrating Innovative Building Envelope Elements

At the BSI seminars, there was a high level of interest about the performance of innovative wall systems that were not "stick-built" wood-frame wall with batt insulation between studs. Although traditional "2 by 6" construction with a wood-based exterior sheathing is typical in many parts of the country, insulated concrete form systems, panelized wall systems (especially in the North), wall assemblies with no insulation in the stud cavity (e.g. thermal insulation placed on the exterior of the stud cavity), wall assemblies that include materials that can fulfill multiple heat, air and moisture control functions (e.g., sprayed-in-place polyurethane foam) were of great interest to the participants. BSI participants often felt that there was not enough independent information on the best ways to apply these technologies and integrate them effectively with other functions and components of the building envelope. Although the value of NRC's Canadian Construction Material Centre (CCMC) evaluation reports for innovative products was recognized, designers and builders expressed a wish for practice manuals that integrate knowledge on innovative elements for durable building envelope systems.

Air Barrier Materials and Air Barrier Systems

Many of the BSI participants indicated on their - evaluation forms that they either had already mastered the building science basics presented, or these were way above their heads. In either case, they felt little need for reviewing the basics. However the requirements for air barrier systems, including rigidity, ability to sustain wind pressures, continuity and durability (i.e. the basics) seemed to receive little attention in their practice because flexible membranes with low air permeance on the exterior of the sheathing board were commonly used for that purpose. Several of these membranes have been granted a CCMC evaluation as an air barrier material, rather than as an air barrier system, meaning that issues of structural capacity, detailing at junctions with other components to ensure effective seals and durability of the air barrier assembly (e.g., at fasteners) had not been part of the scope of the CCMC evaluation protocol. In fact at the present time two proponents of air barrier systems have gone through the full evaluation process for air barrier systems at CCMC[2]. These two air barrier systems use rigid low air permeance thermal insulation as the main airtight element of the exterior walls, i.e. extruded polystyrene board and sprayed-in-place polyurethane foam, and are intended to be located on the exterior of the stud cavity.

Vapour Permeance Distribution Across the Wall Assembly

Vapour permeance of building materials commonly used in wood-frame construction appeared to be an area of confusion and debate. Traditional wisdom has been that the vapour permeance of the external layers of the wall should be much higher than that of the internal layers, to facilitate drying of any small amount of moisture to the exterior, hence adding a level of redundancy in the wall system. Adding a vented air space behind the cladding was also thought to assist in evaporative drying (besides assisting in rain penetration control). However, typical wall assemblies nowadays include materials of low vapour permeance on the exterior layers of the walls, in some cases stacked up directly against each other, without any air space. Predictably, questions were raised about the increased risk of deterioration of the assembly, with the famously referred to "double vapour barrier" situation.

A typical exchange would go as follows:

- "What if moisture gets trapped between two low vapour permeance materials?
- It depends. First, lots of moisture has to get there and accumulate there. There are ways to minimize moisture entry into that space.
- Do not worry about that. Moisture will get there. And it is going to rot.
- Not necessarily. It depends."

Numerical modeling can help qualify the "it depends" and understand the factors that come into play to compare risks of deterioration. In the late 1990s NRC undertook numerical modeling studies on the control of condensation in walls when low permeance materials installed in a relatively airtight fashion (0,1 L/s·m2 at 75 Pa) were placed on the exterior of a stud cavity[3]. The results indicated that the risk of interstitial condensation on the inside face of this low air and vapour permeance assembly would be minimized when it can be maintained above the dew point temperature of surrounding air inwards of this material. One would argue that complex mathematical modeling is not required for that piece of advice. However minimal R-value on the exterior of this low perm assembly was estimated based on a couple of "it depends" factors such as actual weather records, R-value inwards of this assembly and indoor climate loads; these are factors that would be hardly possible to quantify solely on practical field experience. In turn, practical experience ought to support numerical modeling for the development of design guidance, as the reality and variability of the built environment and its response to environmental stimuli remain complex and not fully understood.

(Continued on page 18 ***One Thing is ....)***

[2] CCMC Registry of Product Evaluations can be accessed on-line at *http://irc.nrc-cnrc.gc.ca/ccmc*. The CCMC evaluation procedure for air barrier systems is described in IRC Construction Technology Update No. 46, available at *http://irc.nrc-cnrc.gc.ca/catalogue/ctu.html*

[3] See the NRC publication Construction Technology Update No. 41 Low-Permeance Materials in Building Envelopes, available at NRC website *http://irc.nrc-cnrc.gc.ca/ctus/41.html*

Energy Answers

Nowhere have I read that humidity in the air affects the insulation value of building materials nor the annual cost to heat my house. Yet from experience, we wet coasters (residents of Vancouver) have learned that we must dress warmer when it is damp and cool than our prairie cousins must dress when they are outside in the dry and cold outdoors. Why is it that clothes are affected, but buildings and building insulation materials are not?

Rob, can you help us web-footed folks understand this apparent inconsistency? David Hill

Rob Dumont

For help in answering this question, I went to Dr. Carey Simonson of the University of Saskatchewan Mechanical Engineering Department. Carey is certainly one of the most knowledgeable researchers in the world in this area.

Here was my question to Carey:

Does the thermal conductivity of air increase significantly with increased relative or absolute humidity? (Or is it that clothing that gets damp must evaporate water initially to provide its proper insulating value?)

His answer is that the thermal conductivity of air changes very little with increased humidity. Changing the relative humidity from 0% to 100% RH at 35°C, changes the thermal conductivity of air by less than 1% (in fact it decreases with increasing RH). As you note, evaporation will cause cooling and damp clothing will have a higher thermal conductivity than dry clothing. One thing of interest is that when it is cold outside the RH will nearly always be close to 100% RH. In my opinion, the "damp cold" could be due to two factors:

1) If houses are more humid in a damper climate, clothes will have more moisture, which will reduce their insulating value and also result in more evaporation when a person goes outdoors.

2) The RH could also be greater than 100% (water/ice droplets in the air) due to wind off a nearby lake or ocean.

[Rob Dumont again: When I moved from Vancouver to Saskatoon back in 1970, I kept the same winter coat. I did, however, get some storm cuffs added to the sleeves of that coat to prevent air blowing up my arms.]

What energy efficiency retrofit measures, in your opinion, provide the most financially attractive rates of return?

Let me begin by discussing rates of return. A survey of Canadians done for Natural Resources Canada some years ago suggested that the average Canadian wanted a 20% annual rate of return on energy efficiency measures; in other words, on a $500 investment they want an annual savings of $100. Put another way, the $500 investment would be paid back in five years. This is a very high rate of return.

For comparison, let's look at the actual returns that people have been getting from other relatively safe investments such as bonds, stocks and GICs.

Here are the longer term returns for the past 15 years for typical Canadian investments expressed as compound annual rates of return:

Canadian Bonds–Average Canadian Mutual Fund - 8.34%
Canadian Stocks–Average Canadian Stock Fund - 8.05%
Guaranteed Investment Certificates - 6.4%
Source: Globe and Mail, Returns for the 15 year period ending November 30, 2003

(The actual returns that investors get from bond and stock mutual funds are even lower than those quoted above, as the above figures represent only the surviving funds – at least 1/4 of the funds have folded over that 15 years, usually because of poor performance. Add on purchase fees for mutual funds, and the foolish tendency of mutual fund buyers to pick make their purchases based on last year's winners and assuming the returns will be the same next year, so the actual returns that mutual fund investors achieve are more in the range of a few percent per year. A study by the Dalbar Company in the United States carefully documented the poor returns that the average investor achieved from mutual funds.)

There is a disconnect here. People want 20% rates of return on energy efficiency, and yet must be content with returns in the 3 to 9% range from other safe investments.

My own perspective on investing is that if you can make the long term rate of return of the markets you are doing well. (Hint: Buy and hold index funds with management expense ratios less than about 0.75% per year.)

I apply the same logic to investments in energy efficiency. I'm happy if I can make 6% per year on energy efficiency investments. The following investments, however, do much, much better than 6%.

Let's take an example:

Consider a 15 watt compact fluorescent lamp. Such lamps now are available for about $6 including taxes for a CFL that will replace a 60 watt lamp. I recently bought some with a life of 10,000 hours for that price.

Over the 10,000 hour life of the lamp, the energy saved by that CFL will equal $42 at Saskatoon's electricity rate of 9.36 cents/kilowatt-hour. Assuming that the lamp is burned for 1000 hours a year, the annual rate of return on the lamp is equal to 70%! (While it is true that the lamp must be replaced after 10 years at 1,000 hours per year, the CFL costs roughly the same amount as 10 regular incandescent lamps.) Now if only my other investments could return 70% per year!

If your house is electrically heated, the savings from CFLs are reduced considerably, as the waste heat off the old lamp would be good for space heating. If, however, we assume that the heating season is 8 months of the year, then the energy savings are present only for 4 months of the year. The rate of return from the CFL investment is decreased to about 23% per year - still very respectable.

What are some other very attractive energy saving devices?

Here are my picks:

1. Low flow shower head.

For about $10, the improved shower head should cut the shower flow by about half and return your investment in less than a year. Rate of return: greater than 100% per year.

2. Toilet tank water dams.

The toilet dams reduce the water flow per flush by about one-half. In Saskatoon, our water is relatively cheap, at about $1.00 per cubic meter for residences. Even at that low water price, your investment is returned in less than a year. Rate of return: greater than 100% per year.

3. Night setback thermostat.

At about $50 to $100, the setback thermostat can readily save money if you use it for setbacks. A day and night setback of about 5 degrees C can readily pay back the capital cost within one year. Rate of return: greater than 100% per year.

4. Replacement of an existing refrigerator with an energy efficient unit.

If the existing refrigerator is an older unit, it probably uses more than about 1000 kWh per year. Newer units of the same size use about 500 kWh per year.

One way to look at the economics of a new energy efficient refrigerator is to consider the total cost of the refrigerator and compare that with the annual energy savings. The rate of return, assuming that the new refrigerator costs $700 and the annual energy savings were about 500 kWh per year, would equal about 7% per year - plus you have a newer refrigerator.

Another way to look at the cost is to consider only the incremental cost for the Energy Star rated appliance. Often there is little or no incremental cost to purchase an Energy Star refrigerator. Assuming that the Energy Star refrigerator costs about $50 more than a standard fridge, the rate of return on the extra $50 capital cost would be about 94% per year at Saskatchewan's current electricity rate.

5. Replacement of other appliances such as freezers, dishwashers, and clothes washers.

On the incremental cost to buy an Energy Star appliance, the rates of return are generally very high.

6. Water heater insulating blanket.

Typical storage type water heaters have a jacket heat loss of about 100 watts or 341 BTU/hour continuously through the year. By adding about R20 insulation to the outside of the water heater and insulating the cold and hot water pipes for about a metre, the heat loss can be reduced by about 3/4. The annual savings for an

electric water heater would be $66 at an electricity price of 10 cents per kilowatt-hour. The cost of the blanket would be about $50. Annual rate of return: 132%.

If, however, the house is heated electrically, the rate of return would be reduced to about 44% per year.

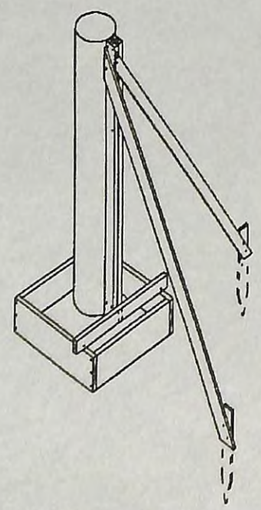
The above devices all have outstanding rates of return, particularly compared to the returns that most investors in mutual funds actually achieve.☼

Continued from page 15

One Thing is For Sure...

Even though the overall understanding of condensation control in exterior walls has made considerable progress in the last decades, there are still concerns. Materials and systems tend to be labeled by their designated function (e.g., vapour barrier, air barrier, insulation) but the wall design must account for the fact that their "other" properties can significantly affect the hygrothermal response of the wall assembly. Typically interstitial condensation problems tend to originate from poor detailing of junctions and interfaces with penetrating materials or products (combined with environmental factors, be it above-average indoor moisture level, pressurization of the indoor space or extreme outdoor conditions). Ensuring the continuity of heat, air and moisture control functions is a key factor to ensure long service life. This has to do with the design as well as the construction phases. Figuring out the detailing of junctions at the design stage to ensure continuity, communicating the design intent to the trades, ensuring proper sequencing of the trades as well as quality control on site are all part of a winning formula. Then the operation of the building kicks in, and some way must be found to ensure that property owners and managers share an understanding and appreciation for what the design team intended for the maintenance of the envelope. There are many opportunities for the chain to break. There are many opportunities to better the application of the "house as a system" and "building players as a team" concepts.

Green architecture may appear to be a relatively new approach to design and construction but in fact long service life and durability of buildings is an important quality of the "greenability" of buildings, two notions definitely not new but still worth thriving for.☼



Fabric Forms for Concrete Columns

Fab-Form Industries Ltd. has always come up with innovative ways to form concrete. First it was fabric footings, which when they use a water resistant fabric also reduce ground moisture wicking through the concrete into the structure.

Their latest product, the Fast-TubeÔ, forms a perfect circular column when filled with concrete. The form is made of polyethylene. It has a fabric tab running the length of the tube that is attached to two 2x4s, enabling the tube to be positioned and braced. The fabric will centre itself when filled with concrete. Being a plastic fabric, it is weatherproof so is unaffected by water and sun.

The forms can be set up in the rain, and are not damaged by wet conditions. Unlike cardboard column forms, fast tube forms generate less waste as they come in 120 ft rolls and can be cut to length with a utility knife.

The forms are engineered for up to 29 ft of liquid concrete head, but the manufacturer suggests a 20 ft height limit.

Information
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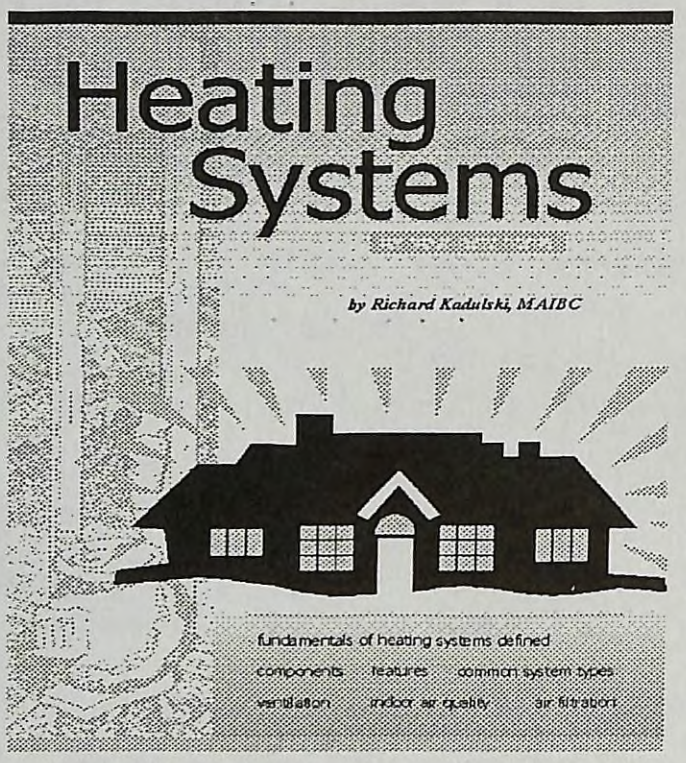
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